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Materiel Test Procedure 5-3-528 U. S. Army Air Defense Board

U. S. ARMY TEST AND EVALUATION COMMAND COMMON SERVICE TEST PROCEDURE

3865

ACCURACY (FIRING)

1. OBJECTIVE

The objective of this material test procedure is to describe the service test methodology, testing techniques, and minimum testing requirements to determine, under simulated tactical conditions, the accuracy of missile or rocket weapon systems, and to evaluate the degree of compliance with accuracy requirements stated in applicable Qualitative Materiel Requirements (QMR), or Small Development Requirements (SDR).

2. BACKGROUND

Firing for accuracy determination is an essential part of the service testing of new or improved missile and rocket systems.

These systems are operated by service personnel under various field conditions of terrain, target deployment and environmental conditions to validate the stated accuracy of each system. The missile and rocket systems discussed in this MTP relate to the following weapons:

- a. Forward Area Support Weapons Assault rockets, antitank missiles, and forward area aid defense weapon systems.
- b. Low Altitude Air Defense Weapons Systems Towed or self-propelled requiring emplacement for action.
 - c. High Altitude Antiaircraft and Missile Defense Weapon System.
 - d. Artillery Missile Systems.

The hitting accuracy of missile or rocket systems employed against surface targets can be determined by conventional methods, similar to those used to evaluate tube artillery, where target interception and/or destruction is determined by distance measurement between the target and projectile impact.

Determining the accuracy of surface-to-air systems is more difficult and requires the implementation of remote sensing devices such as telemetry, and optical tracking including motion picture coverage.

Careful planning is required relative to the significance of each individual launch and the resulting trajectory and function data, due to economic considerations arising from the cost and/or availability of missile rounds, and to a lesser extent the cost of targets.

REQUIRED EQUIPMENT

- Supporting equipment for the test item, including missile rounds.
- Surface Firing Ranges with stationary and moving targets and support facilities. 20040112001

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- c. Aerial Firing Ranges and target control facilities.
- Suitable Aerial Targets, guided and/or ballistic, as applicable.
 - e. Applicable Fire Control Equipment and Firing Tables.
- f. Surveyed flash bases and flash central with operators, as applicable for surface firing.
- g. Aerial Target Position Radars or Doppler Position Systems with operators, as applicable.
 - h. Range Timing System.
- i. Communications Facilities, radio and/or wire, as required for target control and observations, airborne operations, data transmission, range safety, etc.
 - j. Telemetry Equipment.
 - k. Ballistic Cameras.
 - 1. Cinetheolodites.
- Still and Motion Picture Cameras and Film, (black and white or color).
 - n. Meteorological Instrumentation.
 - o. Data Récorders.
- p. Firing Data Reduction Equipment, electronic data processing, as applicable.

4. REFERENCES

- A. Army Regulation 70-10, Army Materiel Testing.
- USATECOM Regulation 385-6, Verification of Safety of Materiel During Testing.
- USATECOM Regulation 705-4, Equipment Performance Report. C.
- USAMC Regulation 385-12, <u>Verification of Safety of Army Materiel</u>. USAMC Regulation 385-24, <u>Range Safety</u>.
- USAMC Regulation 385-62, Firing Guided Missiles and Heavy Rockets for Training, Target Practice and Combat.
- G. USAMC Regulation 385-224, AMC Safety Manual.
- MTP 3-1-002, Confidence Intervals and Sample Size.
- I. MTP 3-3-506, Accuracy and Precision.
- J. MTP 3-3-512, Round-to-Round Dispersion.
- K. MTP 3-3-516, Obscuration.
- MTP 5-1-026, Range Instrumentation Layout.
- MTP 10-3-501, Operator Training and Familiarization.

5. SCOPE

5.1 SUMMARY

The procedures given in this MTP provide general guidance for determining the accuracy of missile and rocket systems.

The specific tests to be performed and their intended objectives are described in succeeding paragraphs: (These tests need not be conducted in the order presented; some may overlap or be performed simultaneously).

- a. Direct Fire, Surface Targets The objective of this subtest is to determine the accuracy of the test item and the degree of operational difficulty when employed by average trained crews to engage and hit stationary or moving targets.
- b. Indirect Fire The objective of this subtest is to determine the accuracy of the test item, and the degree of operational difficulty when employed by average trained crews to hit an indirect target area.
- c. Antiaircraft and Antimissile Fire The objective of this subtest is to determine the accuracy of the test item and the degree of operational difficulty when employed by average trained crews against actual of simulated aircraft and/or missiles, including the evaluation of acceptable levels of kill probability.

5.2 LIMITATIONS

This procedure is limited to accuracy determinations of Army missile and rocket systems employed against surface targets, or aerial targets including aircraft and missiles, but excluding space-borne targets such as satellites.

Although this procedure is intended for use in conjunction with comprehensive service tests of the subject item of missile or rocket systems, including tests of the item in secondary modes of operation, it may be adapted for accuracy tests independent of other service testing.

6. PROCEDURES

6.1 PREPARATION FOR TEST

- a. Select and schedule suitable transportation and operational areas at representative environmental locations, as required by applicable test directive or other appropriate documentation.
- b. Upon establishing the scheduled availability of the test item(s), coordinate the availability of the following:
 - 1) Engineering safety release or other safety statement in accordance with USATECOM Regulation 385-6.
 - 2) Maintenance support facilities, spare parts, and personnel.
 - 3) Equipment, special facilities, and instrumentation with special equipment not readily available at the test site. All test equipment and instrumentation selected shall be in keeping with the state-of-the-art, with calibrations traceable to the National Bureau of Standards.
- c. Select test personnel (soldiers), with the exception of service test supervisors, who are representative of those expected to operate and maintain the test item in the field. Some should be left-handed, some should wear glasses, and some should represent the physical extremes of size.
- d. Ensure that service personnel have been assigned who are trained in the operation and maintenance of the test item in accordance with appli-

cable sections of MTP 10-3-501 and other applicable publications. Record for all service personnel:

- 1) Identity and rank
- 2) MOS
- 3) Training time in MOS
- 4) Experience in MOS
- 5) Training time on subject test item
- 6) Experience in Test Item Crew
- e. Prepare a scenario for a standard operational day (for systems which would normally operate in more than one mode).
- f. Prepare record forms for systematic entry of data, chronology of test, test results, and such observations and measurements that would be of value in analysis and final evaluation of the test item.
- g. Prepare a test item sample plan to ensure that enough samples of all measurements are taken to provide statistical confidence of final data in accordance with MTP 3-1-002. Provisions shall be made for sample plan modification during the test progress as may be indicated by monitored test results.
- h. Ensure that appropriate security measures are instituted to safeguard classified materiel and data, as applicable, and that arrangements for supporting and participating agencies, activities and facilities have been made.
- i. Review the technical literature and prior test documentation on the test item to evaluate:
 - Features influencing the Plan of Test, requiring inclusion of additional procedures and/or observations, or avoidance of unnecessary procedures.
 - Extent of prior testing, for the purpose of avoiding overlap or duplication in service tests.
- j. Facilities and Equipment Ensure the availability of the following:
 - 1) Instrumented surface firing ranges and range operating personnel, as applicable for accuracy tests at short ranges associated with forward area support weapons to long ranges associated with artillery rocket systems, including provisions for indirect fire.
 - 2) Instrumented antiaircraft and/or antimissile firing ranges and range operating personnel, including independent facilities - radar, doppler, or other - for determination of target position.
 - 3) Required supplies of ammunition (missiles or rockets).
 - 4) Assistance of other test agencies for conduct of specialized operations required in the tests, such as airborne operations including target flights, impact area surveillance, electronic environment provisions, etc.

- k. Preoperational Inspection and Physical Characteristics Accomplish in accordance with MTP 5-3-500, including the following:
 - 1) Integrity of packaging of flight components
 - 2) Proper operation of checkout equipment.

6.2 TEST CONDUCT

- NOTE: 1. Safe test procedures shall be followed at all times during firing tests. All test operations shall be observed by cognizant test project personnel, and any unsafe or potentially unsafe condition detected at the test item site or on the range shall cause testing to be suspended until all safety hazards are understood and remedied.
 - 2. When multiple rounds of missiles are launched for effect on the same target, all shall be fired under essentially the same environmental conditions.
 - 3. Accuracy firings of surface-to-air missiles shall be conducted during the full spectrum of weather conditions and environmental conditions as applicable for the subject test item as encountered during test operations. The onset of adverse weather conditions during accuracy firings of surface-to-surface missiles will not cause suspension of test operations unless safety hazards are introduced.
 - 4. Missile rounds used in accuracy tests shall, insofar as practicable, be all from the same lot or other controlled source. Each round shall be fully identified.
 - 5. Provisions shall be maintained at launch sites for proper storage of missile and rocket rounds, including appropriate measures as provided with the weapons system for control of propellant temperatures.

6.2.1 Direct Fire, Surface Targets

- a. Conduct an analysis of the minimum number of launches necessary to develop accuracy data at the short and long range limits of the test item. Consider the performance requirements prescribed by the QMR, SDR, the types of targets simulated, the effects desired, and determine the number of rounds to be fired and the schedule for firing them.
 - b. Establish suitable firing points consisting of:
 - 1) Emplacements of launchers requiring emplacement.
 - Simulated tactical terrain situations for hand-launched missiles or rockets.
- c. As applicable, set up stationary targets. Table I is a guide to the relationship between target size and range.

TABLE I. TARGET SIZE

Range Meters	Target Size, Feet
500	10 x 10
1000	12 x 12
1500	14 x 14
2000	16 x 16

d. As applicable, set up moving targets on suitable tracks, providing crossing and radial passes, consistent with the capabilities prescribed for the test item.

NOTE: Consideration will be given to use of a single moving target track installation for the various distances and directions of target passes, with launch sites disposed accordingly.

e. As applicable, establish suitable impact areas with aiming centers for weapons systems employed against area targets.

6.2.1.1 Launching Procedures

- a. Observe any fields of fire limitations, and ensure that range safety facilities are manned and activated.
- b. Initiate applicable aiming or tracking procedures, and launch the programmed number of rounds.
 - c. Record time and environmental conditions.
 - d. Record missile functioning data and flight path as applicable.
- e. Record impact points, burst points, hits or misses as applicable.
- f. Conduct rapid fire tests for systems having rapid fire capability and record the following:
 - 1) Rate of fire obtained
 - 2) Number of hits versus number of rounds fired
 - 3) Effects of obscuration on rate of reloading

6.2.2 Indirect Fire

6.2.2.1 Preparation

a. Conduct an analysis of the number of launches necessary to

develop accuracy data for the test items using the minimum number of missiles. Consider the performance requirements prescribed by the QMR, or SDR, including the maximum and minimum ranges, and determine the firing schedule and number of rounds to be fired.

- b. Establish emplacement sites in tactical type terrain, and integrate observation, telemetry, and communications networks.
- c. Establish suitable impact areas with aiming centers, representative of the ranges (distance from the launcher) specified in the firing schedule.

6.2.2.2 Launching Procedure

a. Observe any impact area limitations, and ensure that range safety facilities are manned and activated.

NOTE: This test may be conducted using inert warheads or warheads containing a spotting charge, especially if high yield or nuclear warheads are standard in the test item.

- b. Initiate launching sequences and launch the programmed number of missiles.
- c. Record environmental data at launch and impact areas and note significant weather conditions along the flight path if applicable.
- d. Record aiming data as applicable, including coordinates of launching and aiming points, azimuth, quadrant elevation, guidance settings.
 - e. Record missile functioning data and flight path.
 - f. Record coordinates of warhead impacts or bursts.

6.2.3 Antiaircraft and Anitmissile Fire

6.2.3.1 Preparation

- a. Conduct an analysis of the number of intercept events necessary to develop accuracy data for the test item. Consider the intercept envelopes and kill probabilities prescribed by the QMR or SDR, and determine the schedule of target flights and missile launches which will result in comprehensive data using the minimum number of missiles.
- b. Establish launching sites as applicable for the test item, consisting of:
 - 1) Pre-selected sites in tactical type terrain for forward area defense systems which are man-held for launching.
 - 2) Emplacements in tactical type terrain for missile air defense systems.
 - 3) Hardened emplacements as applicable, for missile defense systems.
- c. Establish or coordinate the availability of appropriate fire control and command communications networks, time-coordinated tracking and telemetry facilities, range support and range safety facilities.

d. Establish or coordinate the availability of suitable airborne or ballistic targets, including flight profiles required and times of flights.

6.2.3.2 Firing Procedure

Observe all procedures for target acquisition, tracking, and fire control as prescribed in applicable technical manuals. Proceed as follows:

- a. Ensure that range safety facilities are manned and activated.
- b. Activate aerial target facilities and initiate target flights, providing target passes in accordance with the predetermined schedule.
 - c. Initiate test item's target search and detection operations.
 - d. Engage and fire on targets during each pass.
 - e. Record the following, time-correlated as applicable:
 - 1) Time and environmental conditions.
 - 2) Target track data.
 - 3) Missile track data.
 - 4) Target and missile position data at intercept.
 - 5) Telemetry data on missile and fuze functioning.
 - 6) Observations concerning the overall success of the intercept mission.

6.3 TEST DATA

6.3.1 Preparation for Test

6.3.1.1 Personne1

- a. Record data as applicable on training of personnel as collected under MTP 10-3-501.
 - b. Record the following for all service personnel:
 - 1) Serial number and rank
 - 2) MOS
 - 3) Training time in MOS, weeks4) Experience in MOS, months

 - 5) Training time on test item, weeks
 - 6) Experience in test item crew, weeks

6.3.1.2 Preoperational Inspection and Physical Characteristics

Record data as collected under applicable sections of MTP 5-3-500, including the following:

- a. Photographs of test item and associated equipment, including missiles.
 - b. Photographs of packing and packaging provisions.
 - Photographs of any condition reflecting damage or deterioration.
- d. Critical dimensions and weights, if not available from Engineering Test.

- e. Identity data on test item major components:
 - 1) Nomenclature and Model no.
 - 2) Serial No.
 - 3) Manufacturer.
 - 4) Accumulated operating time, hours or number of cycles.
 - 5) Lot number or other controlled source information for missile or rocket rounds.
- 6.3.2 Test Conduct
- 6.3.2.1 Direct Fire, Surface Targets
- 6.3.2.1.1 Preparation for Test -

Record the following:

- a. Details of the predetermined firing schedule, including a summary statement of the considerations used in making the analysis.
- b. Coordinates of launch sites and target positions, as applicable for the test item and mode of operation.
- 6.3.2.1.2 Launching Procedures -

Record the following:

- a. Date and time of day
- b. Environmental conditions, including:
 - 1) Ambient temperature, degrees F.
 - 2) Relative humidity, percent.
 - 3) Wind direction, degrees, and velocity, mph.
 - 4) Presence of precipitation (rain or snow), light, moderate, heavy.
 - 5) Presence of fog, blowing dust, etc.
- c. Target data, including:
 - 1) For fixed targets, dimensions in feet, distance from launcher, meters.
 - 2) For moving targets, dimensions in feet, speed in mph, direction relative to line of sight, degrees, nominal distance from launcher, meters.
- d. Missile data as applicable, including:
 - 1) Identification of each round.
 - 2) Position on firing schedule.
 - 3) Telemetry data on missile flight functioning and fuze functioning.

- e. Hitting data, including as applicable:
 - 1) Hits on target: horizontal and vertical distance from point of aim, centimeters.
 - 2) Miss distance: short or over, left or right, meters.
 - Burst distance (for influence or timed fuzes), short or over, meters.
 - 4) Area interdicted (for area effect fire), length along flight path by width perpendicular to flight path, square meters.
- f. Rapid fire data as applicable, including:
 - 1) Rate of fire, rounds per minute.
 - 2) Percent effective: number of rounds on target divided by number of rounds fired.
 - 3) Record effects of obscuration, direct observation and motion picture photography.

6.3.2.2 Indirect Fire

6.3.2.2.1 Preparation for Test -

Record the following:

- a. Details of the predetermined firing schedule, including a summary statement of the considerations used in making the analysis.
 - b. Coordinates of launch sites and aiming centers.

6.3.2.2.2 Launching Procedure -

Record the following:

- a. Date and time of day
- b. Environmental conditions at launch and impact sites, including:
 - 1) Ambient temperature, degrees F.
 - 2) Relative humidity, percent.
 - 3) Wind direction, degrees, and velocity, mph.
 - 4) Presence of precipitation (rain or snow) light, moderate, heavy.
 - 5) Presence of fog, blowing dust, etc.
- c. Flight path weather conditions, as applicable, including:
 - 1) Cloud formations, location and nature.
 - 2) Winds aloft, altitude, location of affected area, direction, velocity, mph.
- d. Missile aiming data, as applicable, including:
 - 1) Azimuth and quadrant elevation in mils, or degrees, minutes

and seconds as appropriate.

- 2) Guidance commands in applicable units.
- e. Missile flight functioning data, as applicable, including:
 - 1) Plots of trajectory versus time
 - 2) Telemeter traces of on-board systems functioning
 - 3) Telemeter records of fuze functioning
- f. Impact data, including:
 - 1) Coordinates of impact center, referred to coordinates of aiming center.
 - 2) Warhead effects if applicable.
- 6.3.2.3 Antiaircraft and Antimissile Fire
- 6.3.2.3.1 Preparation for Test -

Record the following:

- a. Details of the pre-determined launch schedule, including a summary statement of the considerations used in making the analysis.
 - b. Coordinates of launching sites.
- 6.3.2.3.2 Firing Procedure -

Record the following:

- a. Date and time of day.
- b. Environmental conditions in the launch/intercept area, including:
 - 1) Ambient temperature, degrees F.
 - 2) Relative humidity, percent.
 - 3) Wind direction: degrees, and velocity, mph.
 - 4) Presence of atmospheric contaminants: fog, rain, snow, dust, etc.
 - 5) Winds aloft in intercept area, altitude, direction, velocity in mph.
- c. Time-coordinated tracks of target and missile, including positions of each at intercept.
 - d. Recordings of missile guidance functions, telemetry.
 - e. Recordings of missile flight systems functioning, telemetry.
- f. Recordings of fuze and warhead functioning, telemetry and photography.
 - g. Observations of damage or destruction of target.
- 6.4 DATA REDUCTION AND PRESENTATION

Accuracy data shall be reduced to the form consistent with accuracy characteristics required and/or prescribed in the QMR or SDR for the respective test item. The forms of accuracy characteristics associated with various missile and rocket systems are discussed in subsequent paragraphs.

All data, including photographs, films, oscillograph traces, tape recordings, or other records, shall be summarized, compared, and evaluated according to procedures described in referenced MTPs, or in this MTP, or equivalent current practice when not covered by MTPs. Appropriate charts, graphs, and tables shall be used to display summaries and comparisons of test data. Coordinates and other major features of charts, graphs, and tables will be selected for clarity and uniformity with the presentations in other reports. Special considerations shall be given to any condition or circumstance which may have significantly influenced test results.

All photographs, motion picture film, oscillograms, tapes, etc., shall be explicitly identified and referenced; significant frames, transcriptions and samples shall be selected for illustrative purposes. All illustrations shall be completely identified.

6.4.1 Miss Distance Data Analysis

6.4.1.1 Surface Targets

Impact location data from multiple rounds may be organized, by methods analogous to those employed with tube artillery, to determine mean point of impact (MPI) for groups of rounds. MPI for small numbers of rounds is found by the arithmetical averages of distances from some convenient reference to the individual impact points in the two coordinate axes. Having the coordinates of the MPI and the point of aim (or predicted point of impact), miss distance can either be calculated or plotted and scaled. For single rounds, launched against fixed targets, miss distance is measured from point of impact to point of aim. For instances of missiles launched against moving targets, miss distance is derived from tracking data by methods analogous to those used for evaluating antiaircraft missiles.

6.4.1.2 Aerial Targets

Analysis of tracking data from missile and target will yield the separation distance between them at intercept (or time of fuze function). Such tracking data can be electronic or optical, or combinations. A common time base is essential for each track of missile and target. Analysis methods will involve maximum use of electronic data processing equipment to insure incorporation of all relevant position points. Positions in space are calculated for the missile and target at the instant of intercept; positions in the approach sequence prior to intercept will be calculated as required to check guidance effectiveness and functioning, to establish as necessary the missile orientation with respect to the target, and to relate the functioning of fuze and warhead to the interception.

6.4.2 Kill Probability

Accuracy test results shall be reported in the same terms as specified in the QMR or SDR. Single shot kill probability expresses the liklihood that a target of specified size, hardness, and location will be destroyed by one launching of a missile having given lethality characteristics. For surface targets, for example armored combat vehicles, single shot hitting probability may be the critereon of evaluation, expressing the probability that one launch of the missile will result in a direct hit. Direct hits are observed and recorded; single shot kill probability is derived from analysis.

In the case of aerial targets, kill probability must take into account the differences between target intercepted and target being simulated. Considering the requirements of the QMR or SDR, determine whether the missile launch resulted in a kill. The following factors shall be considered, as applicable:

- a. Miss Distance
- b. Warhead lethal radius
- c. Warhead directional effects
- d. Physical dimensions of target intercepted
- e. Physical dimensions of target being simulated
- f. Operational envelopes of missile system:
 - 1) Altitude
 - 2) Target speed
 - 3) Target course

Detailed computations of accuracy test results shall be accomplished consistent with requirements as specified in QMR or SDR, limitations of the Test Directive, resources of missiles and data-gathering facilities, and availability of data reduction equipment. Data analysis and presentation shall, in each instance, reflect the substantive interception event in quantitative terms (miss distance in meters, etc.), together with interpretive computations of kill probability demonstrated by the interception.

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APPENDIX A

Suggested Format For An Accuracy Firing Schedule

Interception No.	Target Type	Target Speed	Target Altitude
	(025 252)	(Irnoto)	(modium love high)
	(Q2C, etc.)	(knots)	(medium, low, high)

Interception Number	Course	Range	Weapon Mode	Augmentation	Remarks
	(Incoming, outgoing, left-right, right-left, hovering)	(Minimum, medium, maximum)		(yes, no)	(Maneuvering, attacking, etc.)

NOTES: Firing range identity

Radar Coverage

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Supplemental Instrumentation

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13. ABSTRACT	I					

This Army Service Test Procedure describes test methods and techniques for evaluting the performance characteristics of Missile and Rocket Weapon Systems with regard to their Firing Accuracy. The evaluation is related to criteria expressed in applicable Qualitative Materiel Requirements (QMR), Small Development Requirements (SDR), Technical Characteristics (TC), or other appropriate design requirements and specifications.

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REMARKS

Rosa -- Hope this is the info you're looking for. Any questions, please let me know!

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Proponent for Test Operations Procedures (TOP's)/International Test Operations Procedures (ITOP's) (formerly Materiel Test Procedures (MTP's)) is the Technology Management Division, Directorate for Test and Technology, HQ DTC (formerly TECOM). POC is Mr. Dick Hayes (contractor), DSN 298-1478.

Proponent has reviewed the documents in question and provided the following updated distribution statements. Please note that the last two documents do not belong to HQ DTC.

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